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PUBLIC SPACE TRAVEL—2005: A LEGAL ODYSSEY INTO THE CURRENT REGULATORY ENVIRONMENT FOR UNITED STATES SPACE ADVENTURERS PIONEERING THE FINAL FRONTIER

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THE "SPACE AGE" began on June 21, 2004 when spaceship engineer Burt Rutan and financier Paul Allen sent their suborbital spacecraft, SpaceShipOne, to the edge of Earth's atmosphere and beyond.[1] SpaceShipOne was the first-ever privately funded, manned spaceflight.[2] As the Wright Bothers' historic flight at Kitty Hawk paved the way for public air travel, SpaceShipOne's historic flight at Mojave Airport will pave the way for a new era of public space travel. In this new era, the United States must take the lead. The country and its entrepreneurs who pioneer this new frontier will be instrumental in defining its future, reaping the economic benefits of new industries and new markets. To lead in this new era, the U.S. must challenge old attitudes about space, redefine old markets and formulate new laws. The U.S. space initiative needs a fundamental change to promote this fledgling commercial space industry.

This comment will propose the law and policy needed to assure that U.S. adventurers and industries pioneer this new frontier. First, the comment will address the current state of the space industry, dispelling old myths and explaining the economic environment created by space entrepreneurs. Second, the comment will explore recent shifts in U.S. law and policy that have affected space markets, including the Commercial Space Launch Amendments Act of 2004 ("CSLAA"),[3] recent notices and actions of the Federal Aviation Administration ("FAA")

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[1] Alan Boyle, *Private Rocket Ship Breaks Space Barrier*, MSNBC Interactive, June 21, 2004, http://msnbc.msn.com/id/5261571.

[2] *Id.*

[3] Commercial Space Launch Amendments Act of 2004, Pub. L. No. 108-492, 118 Stat 3974 (codified as amended in scattered sections of 49 U.S.C.S. § 701 (2004)) [hereinafter CSLAA].

and changes in directive at the National Aeronautic and Space Administration ("NASA"). Finally, the comment will explore proposed solutions to help foster the commercial space travel industry.

I. DISPELLING THE MYTH: PRIVATE SUBORBITAL FLIGHT MARKS THE DAWN OF A NEW ERA OF COMMERCIAL SPACE TRAVEL

The myth that the "Space Age" began sometime over the past four decades must be dispelled. It was not the launch of *Sputnik I*,[4] Gagarin,[5] Armstrong,[6] or Tito[7] that marked the beginning of a new era where private citizens could travel into space; it was the flight of Mike Melvill on SpaceShipOne that launched the new era of public space travel.[8] The historic flight highlighted the ability of innovative entrepreneurs to overcome historical impediments to meet the growing public demand for low-cost access to space.[9] "It is time to correct the accident of history that led to governments subsidizing expendable launch vehicles for generations, and thereby deceiving both themselves and the public into believing the myth that space is a barrier rather than

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[4] On October 4, 1957, the Soviet Union successfully launched *Sputnik I*, the first man-made satellite. The basketball-sized satellite weighed 183 pounds and took ninety-eight minutes to complete its elliptical orbit. The launch began the "Space Age" and the official "Space Race" between the U.S. and the Soviets. Steve Garber, *Sputnik and The Dawn of the Space Age*, http://www.hq.nasa.gov/office/pao/History/sputnik/ (last visited Jan. 31, 2006).

[5] On April 12, 1961, Colonel Yuri A. Gagarin became the first human to orbit Earth. Gagarin's spacecraft, *Vostok* 1, circled the Earth for 108 minutes, orbiting at a speed of 27,400 kilometers per hour. Yuri Gagarin, http://www.centennialofflight.gov/essay/Dictionary/GAGARIN/DI169.htm (last visited Jan. 31, 2006).

[6] At 4:18 p.m. on July 20, 1969, the Lunar Module with Neil A. Armstrong and Edwin E. Aldrin landed on the lunar surface while the Apollo command module orbited overhead. Armstrong set foot on the surface, telling the world it was "one small step for a man—one giant leap for mankind." The next day they rendezvoused with the Apollo capsule orbiting overhead and began the return trip to Earth, "splashing down" in the Pacific on July 24. Chronology of Selected Highlights in the First 100 American Spaceflights, 1961-1995, *at* http://www.hq.nasa.gov/office/pao/History/Timeline/100flt.html (last visited Jan. 31, 2006).

[7] On April 28th, 2001, Dennis Tito, the first "Space Tourist," paid twenty million dollars to travel aboard a Russian Soyuz destined for the International Space Station ("ISS"). Tito spent almost eight days onboard the ISS before returning to earth. Space Tourism, *at* http://aerospacescholars.jsc.nasa.gov/HAS/cirr/em/6/7.cfm (last visited Jan. 31, 2006); Wikipedia.org, Dennis Tito, http://en.wikipedia.org/wiki/Dennis_Tito (last visited Jan. 31, 2006).

[8] *See* Boyle, *supra* note 1.

[9] *Id.*

a sea of opportunity."[10] Consumer demand must be met and the industry fostered for sustainable markets to ensue, which will herald the beginning of the real "Space Age."

The flight of SpaceShipOne presented the unique opportunity to create a sustainable commercial space travel industry, which must be seized in the U.S. To achieve a sustainable market, impediments must be removed and incentives must be offered. In Section I, Part A, failures in the commercial space industry will be compared to successes in the commercial aviation industry to determine historical impediments that prevented formation of commercial space markets. In Part B, the current economic environment created by stagnated space markets will be examined to justify the need for a concerted effort to overcome the historical impediments to the industry.

A. Trains, Planes, and Rocketships: Unique Historical Impediments to Commercial Space Travel

There are two principal reasons that the U.S. space industry has been impeded for the past four decades: 1) the non-commercial, governmental origins of the space industry, intrinsically intertwined with national pride and national defense, led to the notion that space was the domain of governments willing to bear the costs of subsidizing an unsustainable launch industry; and 2) national laws and international treaties failed to create a favorable regulatory environment that would stimulate investment, lower entry barriers and limit liability. A comparison between the aviation industry and the space industry highlights the differences in perception, policy and law that resulted in the stagnation of the commercial space industry.

1. Governmental Space Enterprises: Non-Commercial Mentality of a Fledgling Industry Forged to Wage War

The space industry did not follow the successful path of the aviation industry. The commercial aviation industry succeeded for three reasons: 1) entrepreneurs and pioneers engaged the public and stimulated innovation in the industry; 2) guaranteed contracts, prizes, and competitions provided financial incentives for technical achievement; and 3) the U.S. Government sup-

[10] Patrick Collins, Space Tourism: Recent Progress and Future Prospects, presented at Space Technology and Applications International Forum (STAIF-2004) (Feb. 9, 2004), http://www.spacefuture.com/pr/archive/space_tourism_recent_progress_and_future_prospects.shtml (last visited Jan. 31, 2006).

ported efforts to commercialize. None of these characteristics were present during the development of the space industry; thus, the benefits of commercial space travel remained unrealized.

Entrepreneurs and pioneers were integral to the development of the aviation industry. On December 17, 1903, Wilbur and Orville Wright achieved the first powered flight at Kitty Hawk, North Carolina, traveling a mere 120 feet in twelve seconds.[11] While the accomplishment of powered flight was the focus of Kitty Hawk, the ability of two bicycle-shop entrepreneurs to create an innovative new plane, designed in a wind tunnel to maximize lift, had a more lasting legacy on commercial aviation history.[12] The private efforts of entrepreneurs led to continued airplane development prior to World War I ("WWI"). However, the U.S. soon lost the leadership position in the aviation industry to European innovators fueled by an arms race and WWI.[13]

Critical to the success of the industry was keeping U.S. entrepreneurs and pioneers involved in the developmental process, despite losing the lead in aviation. During the interwar period in the U.S., private efforts developed the aviation industry.[14] A surplus of planes and pilots after WWI led to the barnstorming era where pilots flew into small towns across the country to show off their flying skills and to take paying passengers on rides.[15] Amelia Earhart and Charles Lindbergh were famous byproducts of the barnstorming era and went on to achieve many records.[16] Barnstormers engaged the public and created a market for pay-

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[11] The First Powered Flight – 1903, CFC, http://www.centennialofflight.gov/essay/Wright_Bros/First_Powered_Flight/WR6.htm (last visited Jan. 31, 2006).

[12] Peter L. Jakab, *Visions of a Flying Machine – The Wright Brothers and the Process of Invention* 122-123 (1990); *see generally* Further Gliding and Wind Tunnel Experiments - 1901, http://www.centennialofflight.gov/essay/Wright_Bros/1901/WR3.htm#_ftnref1 (last visited Jan. 31, 2006).

[13] Asif Siddiqi, *The Beginnings of British Commercial Aviation*, http://www.centennialofflight.gov/essay/Commercial_Aviation/britain/Tran18.htm (last visited Jan. 31, 2006); Judy Rumerman, *The National Advisory Committee for Aeronautics (NACA)*, http://www.centennialofflight.gov/essay/Evolution_of_Technology/NACA/Tech1.htm (last visited Jan. 31, 2006).

[14] Judy Rumerman, *American Aircraft Manufacturing*, http://www.centennialofflight.gov/essay/Aerospace/post_WWI/Aero6.htm (last visited Jan. 31, 2006).

[15] David H. Onkst, *Barnstormers*, http://www.centennialofflight.gov/essay/Explorers_Record_Setters_and_Daredevils/barnstormers/EX12.htm (last visited Jan. 31, 2006).

[16] Keri Rumerman, *Amelia Earhart*, http://www.centennialofflight.gov/essay/Explorers_Record_Setters_and_Daredevils/earhart/EX29.htm (last visited Jan. 31, 2006); Charles A. Lindbergh, http://www.centennialofflight.gov/essay/Dictionary/lindbergh/DI189.htm (last visited Jan 31, 2006).

ing passengers, sustaining the industry during the interwar years.

Guaranteed contracts, prizes and competitions spurred innovation, helping the commercial aviation market develop. The Army and Post Office quickly saw the benefit of airplanes and offered a guaranteed minimum number of contracts for a plane that met certain design, control and durability requirements.[17] The guaranteed contracts created a large financial incentive to make rapid improvements in safety and design, while decreasing costs.[18] Rapid developments allowed an airmail route to be established by 1918.[19] Private sponsors also encouraged aviation entrepreneurs to innovate by funding awards and prizes that improved design and performance. One such example is the $25,000 Orteig Prize that Lindbergh received on May 20, 1927, when he was the first to fly solo nonstop across the Atlantic.[20] The post-war barnstorming era also led to a series of competitions, races and aerobatic feats, which drove engine and airframe development later used by the military in World War II ("WWII").[21]

Finally, governmental efforts were critical to the commercialization of the aviation industry. In 1915, Congress took a step toward revitalizing American aviation by establishing the National Advisory Committee for Aeronautics ("NACA"), an organization dedicated to the science of flight and the predecessor to NASA.[22] The goal of the organization was to support private entrepreneurs in their attempts to improve design, safety and reliability, which are precursors to a viable commercial aviation

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[17] Edmund Preston, *The Government Role in Civil Aviation/An Overview*, http://www.centennialofflight.gov/essay/Government_Role/POL-OV.htm (last visited Jan. 31, 2006); Rich Freeman, *The Pioneering Years: Commercial Aviation 1920-1930*, http://www.centennialofflight.gov/essay/Commercial_Aviation/1920s/Tran1.htm (last visited Jan. 31, 2006).

[18] *Id.*

[19] *Id.*

[20] Charles A. Lindbergh, *supra* note 16. Eight years before Lindbergh's solo flight on the "Spirit of St. Louis," Captain John Alcock and Lieutenant Arthur Brown flew nonstop across the Atlantic, winning the £10,000 ($50,000) Northcliffe prize. Wikipedia.org, Aviation History, http://en.wikipedia.org/wiki/Aviation_history (last visited Jan. 31, 2006).

[21] David H. Onkst, *The Major Trophy Races of the Golden Age of Air Racing*, http://www.centennialofflight.gov/essay/Explorers_Record_Setters_and_Daredevils/trophies/EX10.htm (last visited Jan. 31, 2006); Aviation History, *supra* note 20. For example, the Schneider Trophy led to a series of improved monoplane designs culminating in the Spitfire. *Id.*

[22] Preston, *supra* note 17; Rumerman, *supra* note 13.

industry.[23] Furthermore, after WWI, Congress passed legislation to facilitate commercialization of aviation. The Air Mail Act of 1925 authorized the Post Office to contract with private airliners to transport mail, providing a steady income to sustain America's struggling air carriers.[24]

Over the past century, the commercial aviation market expanded to become a sustainable industry. The continuous cycles of innovation, spurred by entrepreneurial efforts, financial incentives and governmental efforts to commercialize the industry, culminated in the integration of jet technology after WWII.[25] Jet technology offered unmatched reliability, safety and cost.[26] The success of commercial aviation was virtually assured.[27]

Historically, the U.S. space program has not followed the successful path of commercial aviation. "From the beginning of the Space Age most American Policy makers assumed that government[s] would be the actors operating in space and thus made no allowance for private actors."[28] Space travel, like aviation, had an entrepreneurial start.[29] Rocketry, the predecessor to manned space travel, began in America with the private work of Robert Goddard.[30] Interestingly, Goddard's work was closely related to the commercialization of aviation, with Lindbergh sug-

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[23] *Id.* (discussing a more aerodynamic engine cowling created in wind tunnels by NACA).

[24] Rumerman, *supra* note 14; Preston, *supra* note 17.

[25] Asif Siddiqi, *The Opening of the Commercial Jet Era,* http://www.centennialofflight.gov/essay/Commercial_Aviation/Opening_of_Jet_era/Tran6.htm (last visited Jan. 31, 2006).

[26] T.A. Heppenheimer, *Jet Engines,* http://www.centennialofflight.gov/essay/Evolution_of_Technology/jet_engines/Tech24.htm (last visited Jan. 31, 2006).

[27] Asif Siddiqi, *The Era of Commercial Jets,* http://www.centennialofflight.gov/essay/Commercial_Aviation/Jet_Era/Tran7.htm (last visited Jan. 31, 2006). Airline deregulation in the 1980's, when combined with an economic recession and higher fuel costs, led to the demise of many major air carriers. Asif Siddiqi, *The Airline Bankruptcies of the 1980's,* CFC, http://www.centennialofflight.gov/essay/Commercial_Aviation/Bankruptcy/Tran9.htm (last visited Jan. 31, 2006).

[28] *Space Policy and Tourism: Hearing Before the Subcommittee on Space & Aeronautics* 107th Cong. (2001) (statement of Edward L. Hudgins, Ph.D, Cato Institute) (June 26, 2001), http://www.cato.org/cgi-bin/scripts/printtech.cgi/testimony/ct-eh062601.html.

[29] T.A. Heppenheimer, *Early U.S. Rocketry,* http://www.centennialofflight.gov/essay/SPACEFLIGHT/early_rocketry/SP7.htm (last visited Jan. 31, 2006).

[30] *Id.*

gesting to the Guggenheim Foundation that Goddard's work deserved a grant.[31] However, rockets became missiles.

Despite private origins, space technology was quickly equated with the military capabilities of a nation, projecting power and pride. During WWII, the Germans utilized space technology to create the V-1,, and eventually, the V-2 rocket.[32] While the rockets did not alter the tide of the war, the U.S. quickly realized the importance of this new technology and convinced Wernher von Braun and his rocket team, all of whom were post-war German immigrants, to head the space effort.[33] Cold War events would virtually assure a non-commercial future in space.

The launch of *Sputnik I* solidified the conclusion that governments, not entrepreneurs, should lead the U.S. effort in space, hampering the next four decades of commercial space travel.[34] The launch of *Sputnik I* meant that the Soviets beat the U.S. to space and did so with an object weighing fifty times that of its American equivalent.[35] Despite Eisenhower's attempt to downplay the launch, public reaction altered the development of space markets.[36] "The launch of *Sputnik I* had a Pearl Harbor effect on American public opinion," directly challenging American technical dominance.[37] "The Soviet success with *Sputnik I* raised, in a very fundamental way, the question of American technological virtuosity and questioned American capability."[38] In the post-*Sputnik* era, the government sacrificed long-term sustainable space travel for immediate achievements that would erase the perception of a technological gap between the U.S. and the Soviets.[39] The decision to combat the Soviet threat with

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[31] *Id.*; Judy Rumerman, *Daniel & Harry Guggenheim—Supporters of Aviation Technology*, http://www.centennialofflight.gov/essay/Evolution_of_Technology/guggenheim/Tech3.htm (last visited Jan. 31, 2006).

[32] Dr. David P. Stern, *The Evolution of the Rocket*, http://www-istp.gsfc.nasa.gov/stargaze/Srockhis.htm (last visited Jan. 31, 2006); Dwayne A. Day, *The V-2 (A4) Ballistic Missile Technology*, http://www.centennialofflight.gov/essay/Evolution_of_Technology/V-2/Tech26.htm (last visited Jan. 31, 2006).

[33] Day, *supra* note 32; T.A. Heppenheimer, *Postwar U.S. Rocketry*, http://www.centennialofflight.gov/essay/SPACEFLIGT/postwar_rocketry/SP8.htm (last visited Jan. 31, 2006); Heppenheimer, *supra* note 29.

[34] Roger D. Launius, *Sputnik and the Origins of the Space Age*, http://www.hq.nasa.gov/office/pao/History/sputnik/sputorig.html (last visited Jan. 31, 2006).

[35] *Id.*

[36] *Id.*

[37] *Id.* (internal citations omitted).

[38] *Id.*

[39] *See id.*; Hudgins, *supra* note 28.

a governmental bureaucracy, instead of reaching out to U.S. entrepreneurs, is a principal reason for stagnation in the space industry.

Governmental efforts to equate space with military prowess also prevented the formation of commercial space markets. Within one year of *Sputnik I*, Congress passed the National Aeronautics and Space Act of 1958 ("Space Act"), which converted the NACA, a loosely knit apolitical civilian organization, into a governmental bureaucracy called NASA.[40] NASA "plan[ned], direct[ed], and conduct[ed] aeronautical and space activities."[41] Despite the stated benign goal of bettering mankind, the sole reason for NASA's creation was to restore national pride by beating the Soviets to the moon.[42] While NASA's goals were admirable, the organization lost many of its characteristics that had fostered entrepreneurial efforts in the commercial aviation industry.[43] The newly formed NASA did not seek to support a commercial space industry, as NACA had with aviation.[44] Moreover, the creation of NASA, at the very least, pitted a powerful governmental bureaucracy against private industry. Finally, NASA's objective became political in nature, as the entire nation rested its hopes on the government's efforts to beat the Soviets.[45]

The U.S. Government also inhibited commercial space markets by using space as a military platform to exert national power. Over the past 40 years, the U.S. created a network of communication, remote sensing and positioning satellites that relay information and data for the Armed Forces, functioning as

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[40] National Aeronautics and Space Act of 1958, Pub. L. 85-868, 72 Stat. 429 (codified as amended at 42 U.S.C. §§ 2451-84 (2000)) [hereinafter Space Act]; Garber, *supra* note 4.

[41] Space Act § 203(a)(1)-(3).

[42] Space Act § 102(a); Garber, *supra* note 4; *Commercialization of Space: Commercial Space Launch Amendments Act of 2004*, 17 HARV. J. L. & TECH. 619, 621 (2004) [hereinafter Harvard Note].

[43] Launius, *supra* note 34.

[44] *See* Space Act, *supra* note 40. In 1984, Congress amended the Space Act requiring NASA to "seek and encourage, to the maximum extent possible, the fullest commercial use of Space." Space Act, Pub. L. 98-361, 98 Stat. 427 (codified as amended at 42 U.S.C. §§ 2451-84 (1984)).

[45] Launius, *supra* note 34; John M. Logsdon, *The Politics of Space: Understanding Space Policymaking*, http://www1.jsc.nasa.gov/er/seh/political.html (last visted Jan. 31, 2006); The National Aeronautics and Space Administration, http://www.centennialofflight.gov/essay/Evolution_of_Technology/NASA/Tech2.htm (last visited Jan. 31, 2006).

the backbone of our national-defense structure.[46] The satellite assets operated in the void of space, protected only by the enemy's inability to access them.[47] Over-reliance on these space assets resulted in the U.S. adopting a "space assurance" doctrine, which protected U.S. assets by denying adversaries access to space.[48] Specifically, the "space assurance" doctrine limited the flow of information, raised barriers to enter the market and used price to prevent access to space.[49]

First, the initial failure to reach out to private industry cemented the perception that the government could best conduct space activities. Second, there were no contracts, rewards or other incentives to promote private investment in launch vehicles. Third, the resulting monopolistic governmental bureaucracy stifled innovation normally encountered in competitive commercial markets. These principal factors, when combined with adverse space law, led to the commercial space travel industry in America advancing no further than the initial efforts to put man into space.

2. *Unfavorable Regulatory Environment: For the Betterment of Mankind But Not the Commercial Space Industry*

The formulation of space law over the past forty years also limited the development of commercial space markets. Despite success with the commercial aviation market, national laws and international treaties did not attempt to duplicate the regulatory structure for space markets. Two principal factors contributed to the success of the aviation industry: 1) domestic regulation successfully balanced the risks associated with innovation and safety, adding regulation only when safety concerns threatened a sustainable aviation industry;[50] and 2) international treaties solidified world support for the aviation industry, laid a clear legal framework that would apply to international passengers and limited air carrier liability.[51]

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[46] *See* John M. Logsdon, *Reflections on Space as a Vital National Interest*, Astropolitics (2003).

[47] *Id.*; James A. Lewis, *China as a Military Space Competitor*, Center for Strategic and International Studies (Jan. 2004).

[48] Logsdon, *supra* note 46, at 11; *see* Lewis, *supra* note 47.

[49] *Id.*

[50] *See* Preston, *supra* note 17.

[51] *See* Convention for the Unification of Certain Rules Relating to International Transportation by Air, *opened for signature* Oct. 12, 1929, 49 Stat. 3000, 137 L.N.T.S. 11, *reprinted in* 49 U.S.C. § 40105 (West 2001) [hereinafter Warsaw Convention].

Limited domestic regulation is the principal reason for aviation's success. For the two decades after the Wright Brothers' historic flight, the aviation industry was unregulated.[52] The absence of regulation led to rapid advances in technology, especially during the barnstorming era.[53] However, by the mid-1920s, the technical achievements were accompanied by highly public failures, prompting industry leaders to believe federal regulation was necessary to restore public confidence in the safety of air transportation.[54] "Planes were falling out of the sky on a regular basis, with aircraft fatality rates that would translate into more than 250,000 deaths per year in modern times."[55] In response to industry concerns, Congress passed the Air Commerce Act of 1926 ("ACA").[56] Under the ACA, the Department of Commerce ("DOC") was responsible for improving the safety of civil aviation and for cooperating with the industry to further develop aviation markets.[57] The DOC's duties included testing and licensing pilots, issuing aircraft airworthiness certificates, promulgating safety regulations, and investigating airplane accidents.[58] However, the most significant improvements in safety occurred over the next decade as the DOC worked with the industry to upgrade the aviation infrastructure in America by adding airway lighting beacons, radio towers, and suggesting the use of other technological advancements.[59] In 1938, Congress passed the Civil Aeronautics Act, which created a more centralized civil aviation authority further authorized to regulate airline fares and determine the routes that air carriers could serve.[60]

Another two decades would pass before new legislation significantly affected aviation markets.[61] As the jet age approached, midair collisions increased, prompting the passage of the Federal Aviation Act of 1958 ("Aviation Act"), which established the

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[52] *See* Preston, *supra* note 17.

[53] *Id.*; *see supra* notes 16-22 and accompanying text.

[54] *See* Preston, *supra* note 17; Charity Trelease Ryabinkin, Note, *Let There Be Flight: It's time to reform the Regulations of Commercial Space Travel*, 69 J. AIR L. & COM. 101, 104 (2004).

[55] Ryabinkin, *supra* note 54, at 104.

[56] Preston, *supra* note 17.

[57] *Id.*

[58] *Id.*

[59] *Id.*

[60] *Id.*

[61] *Id.*

Federal Aviation Administration ("FAA").[62] The FAA was charged with creating safety regulations and a common civil-military system of air navigation and control.[63] By 1968, the FAA became more involved with the environmental aspect of aviation, and by 1995, the agency assumed responsibility for safety oversight of commercial space transportation.[64]

Internationally, the Warsaw Convention ("Convention") supported commercial aviation by addressing industry needs before they became an issue. On October 12, 1929, twenty-six years after the first powered flight and well before commercial aviation was a sustainable market, world leaders completed the Convention, creating an international regulatory structure that dealt with commercial and legal issues that would arise from the international transportation of persons and baggage.[65] First, the passage of the Convention gave a clear signal of worldwide support for the commercial aviation industry. Second, the Convention defined passengers, baggage and operations, creating a clear regulatory framework that offered guidance to airlines and passengers.[66] Third, the Convention afforded the passengers certain rights while limiting an airline's liability to its negligent acts.[67] The Convention's limited-liability provisions had two positive effects: 1) capital was freed to invest in technological improvements and to expand into new international markets; and 2) the airlines were able to reach out to insurers to minimize risk.[68]

Aviation law passed with the support of industry at a time when it would not threaten the market. Moreover, international law was progressively hammering out any impediments, principally liability, that may have prevented investment in and expansion of the market. Early on, officials realized that the short-term problems caused by unsafe aircraft were more than offset by the emergence of an international aviation market.

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[62] *Id.*; *see The Opening of the Commercial Jet Era*, *supra* note 25; *The Era of Commercial Jets*, *supra* note 27.

[63] Preston, *supra* note 17.

[64] *Id.*

[65] *See* Warsaw Convention, *supra* note 51.

[66] Warsaw Convention, *supra* note 51, art. I.

[67] Warsaw Convention, *supra* note 51, arts. XVII-XXX.

[68] Patrick Collins & Koichi Yonemoto, *Legal and Regulatory Issues for Passenger Space Travel, International Symposium on Space Law*, 49th IAF Congress (Sept. 28, 1998), http://www.spacefuture.com/archive/legal_and_regulatory_issues_for_passenger_space_travel.shtml.

Conversely, space law limited the development of space markets by over-regulating an unsustainable industry. Contrary to the history of aviation, the space industry began with heavy regulation, which has since been deregulated over the years. The most obvious example is the Space Act, the first significant piece of space legislation, which was passed before America entered space.[69] The Space Act gave NASA the authority "to make, promulgate, issue, rescind, and amend rules and regulations,"[70] but it did not authorize NASA to promote the commercialization of space.[71] The initial regulation that prohibited commercialization became more restrictive with time, as an increasing number of Federal and State bureaus claimed jurisdiction in regulating space activities.[72] In 1984, President Reagan made substantial changes in the regulatory structure in an attempt to centralize launch regulatory authority and transition to a commercial space industry.[73] By 1995, the FAA received launch regulatory authority in the newly renamed Office of the Associate Administrator for Commercial Space Transportation ("FAA-AST").[74] However, attempts to commercialize and improve the regulatory structure were not enough to help the industry. First, efforts to commercialize were thwarted by regulatory restrictions, such as the ban of government payloads on private rockets.[75] Second, the improved regulatory structure promulgated by the FAA-AST still prohibited entry into the market by imposing costly and voluminous licensing requirements.[76]

The Commercial Space Act of 1998 ("CSA") attempted to remove barriers imposed on private companies in the space market.[77] Notably, the CSA removed a ban restricting private enterprises from bringing back humans, payload, and re-entry vehicles.[78] The CSA attempted to foster commercialization by re-

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69 Space Act, *supra* note 40.

70 *Id.* at § 203(b)(1).

71 *See generally* Space Act, *supra* note 40.

72 Harvard Note, *supra* note 42, at 625 n.44.

73 *Id.*

74 *Id.* at 625.

75 Hudgins, *supra* note 28. The 1986 Challenger disaster helped remove the ban of government payloads on private rockets. *Id.*

76 *Id.* The 1982 private launch of the Conestoga rocket brought to light the regulatory barriers to private companies. The rocket's maker had to spend six months and $250,000 to get permission to launch. *Id.*

77 *See* Commercial Space Act of 1998, Pub. L. 105-303, 112 Stat. 2845 (codified as amended in scattered sections of 49 U.S.C.S. § 701 (1998)) [hereinafter CSA].

78 *Id.*; Hudgins, *supra* note 28.

quiring NASA to purchase services instead of hardware. However, due to lack of enforcement, NASA did not have to honor this mandate.[79] The CSA also formally assigned to the FAA definitive control to regulate space launches and landings.[80] However, even though the CSA vested launch and reentry regulation to the FAA-AST, many licenses and permits were still required from different governmental departments to launch a vehicle.[81] Even within the FAA, multiple licenses were required, as authority to license and regulate were based on launch vehicle specifications.[82] If thrust exceeded lift, the FAA-AST had regulatory authority.[83] However, conflicts arose as newer reusable launch vehicles ("RLVs") incorporated innovative approaches that defied these simple regulations.[84] For example, suborbital RLVs may be launched from a plane and after achieving orbit, may glide to Earth for a safe landing.[85] Both the initial trip up on the plane and the gliding return to earth would fall under the FAA, while the launch—the actual burn of the rockets—would be regulated by the FAA-AST.[86] The multiple licenses required by this regulatory structure restricted entry into the market by private RLV manufacturers.[87] While an improvement over existing legislation, the CSA failed to lower entry barriers and to engage private enterprise to the levels necessary for the creation of a sustainable space market.

Similarly, international treaties have thwarted the creation of space markets. The commercial space industry, unlike the aviation industry, experienced international treaties, that 1) solidified world support against the space industry; 2) created a legal framework that inhibited growth of commercial space markets;

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[79] Hudgins, *supra* note 28.

[80] *Id.*; CSA § 70119.

[81] Harvard Note, *supra* note 42, at 625.

[82] *Id.*

[83] *Id.*

[84] *Id.*

[85] *Id.*

[86] *Id.*

[87] Hudgins, *supra* note 28. J.P. Aerospace of California was competing for the private Cheap Access to Space prize of $250,000 for placing a payload 124 miles above the Earth by November 8, 2000. It began the effort to secure permission to launch in May, 2000. The company was informed in late September by the government that it would take another two months to process the license. J.P. Aerospace missed the deadline. *Id.* For an interesting discussion on pre-2005 liability and regulatory requirements required by the FAA, please see the note prepared for the Space Law Seminar taught by Paul B. Larsen. Ryabinkin, *supra* note 54, at 119-28.

and 3) established potentially unlimited strict liability for launching nations. There are three pertinent Space treaties that led to stagnation in commercial space markets: 1) the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space ("Outer Space Treaty"); 2) the Convention on International Liability for Damage Caused by Space Objects ("Liability Convention"); and 3) the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies ("Moon Agreement").

The Outer Space Treaty, adopted unanimously by the United Nations General Assembly in 1963, has many declarations that inhibit commercial space travel.[88] The Outer Space Treaty governs the appropriation of space resources and, like the Space Act, unnecessarily proscribes conduct.[89] The treaty declares that "[o]uter space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."[90] While an incredibly fair compromise, the declaration removes financial and ownership incentives to explore space and celestial bodies.[91] Moreover, activities in outer space, whether by governmental agencies or non-governmental entities, "shall require authorization and continuing supervision" by the State concerned.[92] Finally, States are liable for the actions of State entrepreneurs.[93] First, objects launched for or within a State are deemed objects of that State.[94] Second, each State is "internationally liable for damage to another State Party or to its . . . persons by such object or its component parts on the Earth, in air, or in outer space."[95] The Liability Convention uses stronger language stating that a "State shall be absolutely liable to pay compensation for damage caused by its space object."[96] These treaties have the chilling effect on the commercialization of

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88 *See* Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. 6347 [hereinafter Outer Space Treaty].

89 *Id.*

90 *Id.* art II.

91 *See id.*

92 *Id.* art VI.

93 *See id.* art VI-VII.

94 *Id.* art VI.

95 *Id.* art VII.

96 Convention on International Liability for Damages Caused by Space Objects, Sept. 1, 1972, 24 U.S.T. 2389, art II, T.I.A.S. 7762 [hereinafter Liability Convention].

space by making governments liable for private commercial efforts conducted within their borders.[97] Failure to alleviate liability risk reduced available capital for innovation and restricted the ability to reach out to insurers to minimize risk.[98]

The Moon Agreement, an attempted expansion of the Outer Space Treaty, has further inhibited the commercial space market by creating ambiguity in international law that dissuades investors and entrepreneurs from taking risks in space.[99] Specifically, the treaty restricts private claims of ownership in outer space or on celestial bodies.[100] According to the wording, everything in outer space, from cosmic dust to a plot on the moon, is unavailable to governments or private entities. The Moon Agreement was not ratified by the U.S. However, the long-standing uncontested body of customary international law shows resistance from the international community in acknowledging new rights for any party or government in space.[101]

Domestic and international space law prevented the formation of commercial space markets. Aviation's history illustrates the two reasons why space law failed to promote the commercial space industry: 1) domestic space law overregulated safety, failed to engage private enterprise to expand space markets, and created entry barriers to the market due to excessive licensing requirements; and 2) the international community failed to address issues involving the commercialization of space and, instead, created a prohibitive legal framework and potentially unlimited strict liability. Thus, to overcome regulatory impediments, space law must engage private industry, lower barriers into the market and help manage risk and liability. The unrealized economic benefit of public space travel warrants changes in perception, policy and law to remove historical impediments to the U.S. space industry.

B. WHY IT MATTERS: THE UNREALIZED ECONOMIC BENEFIT OF PUBLIC SPACE TRAVEL

Historical impediments stagnated innovation and expansion of markets, leaving the economic benefit of commercial space travel unrealized. The detrimental effects resulting from stagna-

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[97] *Id.*; Outer Space Treaty, *supra* note 88, art VII.

[98] *See* Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 5, 1979, 1363 U.N.T.S. 3 [hereinafter Moon Agreement].

[99] *Id.*

[100] *Id.*

[101] *Id.*; Outer Space Treaty, *supra* note 88, art II.

tion are: 1) stifled innovation and restricted markets; 2) unrealized industries and technologies developed in commercial markets; and 3) a degraded military space infrastructure unable to protect current space assets vital to national security.

Excluding private industry at the beginning of the space race denied space markets the cumulative effect of entrepreneurial innovation. As a result, innovations have come slowly and launch costs have remained high. Despite early exclusion of private industry, the space market partially commercialized in recent times, specifically in the satellite industry.[102] However, the satellite industry is a limited market, incapable of providing the financial rewards necessary to spawn the continuous cycle of design and safety improvements experienced in the aviation industry.[103] Without expansion of the market to include public space travel, the U.S. launch industry appears unsustainable without government subsidization.[104] First, while demand for satellite bandwidth is increasing, the technical capabilities of satellites have increased to a point where fewer, not more, launches are needed.[105] Second, the U.S. launch industry has lost ground to foreign competitors who have captured approximately seventy percent of the existing commercial market of approximately sixty launches per year.[106] Third, expendable launch vehicles do not offer the return on capital necessary to research and test new RLVs, which are a necessary precursor to a sustainable space industry.[107] "If aviation had grown as slowly, the first paying customer would have flown in 1943—in the 1,657th expendable right flyer."[108] Thus, partial efforts to commercialize have proven insufficient to spawn innovation and expand space markets.

Without innovation and expansion of space markets, new industries and technologies developed slowly. Using aviation history as a guide, the slow development of space markets resulted in a loss of high-tech jobs and technologies necessary to support

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[102] Derek Webber, Member, AIAA Lessons of Ascent—Messages for Industry, The Federal Government and Spaceport Authorities, Address at Space 2003 (Sept. 2003), http://www.spacefuture.com/archive/lessons_of_ascent_messages_for_industry_the_federal_government_and_spaceport_authorities.shtml.

[103] *Id.*

[104] *Id.*

[105] *Id.*

[106] *Id.*

[107] *Id.*; Collins, *supra* note 10, § 1-2.

[108] Patrick Collins, *Space Tourism: A Remedy for 'Crisis in Aerospace'*, AVIATION WEEK & SPACE TECHNOLOGY, Dec. 10, 2001, at 98.

a commercial space industry.[109] The aviation industry advanced rapidly, creating new jobs in aviation, hospitality and other supporting industries.[110] The resulting need for infrastructure also created new jobs and technologies.[111] The effects of aviation and aviation technologies over the past century can be felt in almost every industry in almost every nation.[112] The space industry has not generated the same benefits.[113] More importantly, the slow development of space markets placed a burden on traditional markets.[114] The U.S. faces tough competition in traditional industries where a cheaper labor force helps generate greater corporate profits.[115] The loss of jobs and industries to overseas competitors creates an imbalance in trade and encourages the government to intervene in the market.[116] Intervention creates tensions between the U.S. and developing nations that benefit from outsourcing.[117] The stagnation of space markets has denied new industries and technologies, while adding to the growing list of foreign policy concerns.

The failure to create a sustainable space industry has put current U.S. space assets at risk. Initially, space satellites and other assets were protected by their inaccessibility. However, as other countries have acquired access to space, some now question whether there is a fundamental over reliance of the U.S. military on space-based assets.[118] The increased capabilities of nations, such as China, allow for an asymmetrical advantage over the U.S. in outer space.[119] Simply put, nations do not need to match the U.S. satellite-for-satellite to assert space dominance.[120] Relatively low-cost and easy-to-launch "killer-satellites" can negate the space infrastructure developed by the U.S. over the past forty years.[121] U.S. policy-makers fear a "space Pearl

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[109] T. A. Heppenheimer, *Air Transport – Commercial Aviation*, http://www.centennialofflight.gov/essay/Commercial_Aviation/Tran-OV.htm (last visited Jan. 31, 2006).

[110] *Id.*

[111] *Id.*

[112] *Id.*

[113] Collins, *supra* note 10, § 5.

[114] *Id.*

[115] *Id.*

[116] *Id.*

[117] *Id.*

[118] John M. Logsdon, *Just Say Wait to Space Power*, Issues in Science and Technology, Spring 2001, at 75-76.

[119] *See id.*; Lewis, *supra* note 47.

[120] *See* Lewis, *supra* note 47.

[121] *Id.*

Harbor—a surprise attack on important space assets."[122] Destruction of current U.S. space assets would result in a loss of space dominance and a potential loss of military dominance on earth.[123] While some call for a reduction in space based assets, others call for militarization of space.[124] This debate is germane because policy stagnated innovation in the industry.[125] Despite stagnation, entrepreneurial pioneers still seek to overcome historical impediments to help realize the economic benefits of commercial space travel.

II. SEPARATION BETWEEN GOVERNMENT AND SPACE: A SMALL STEP FOR U.S. SPACE ENTERPRISES

The real "Space Age" is now upon us; *Carpe Diem*! Two recent changes in the U.S. space industry pave the way for sustainable space markets: 1) Entrepreneurs and pioneers broke the governmental monopoly on space, demonstrating that private innovations increase safety and decrease price; and 2) CSLAA removed many significant domestic regulatory barriers, which increased available capital, lowered entry barriers into the market, and limited liability. International law still inhibits industry growth, and suggested changes will be addressed when evaluating future solutions in Section III. Despite needed changes in international law, recent adjustments in the space industry will likely reverse the stagnation of commercial space markets.

A. THE REAL SPACE AGE: PRIVATE ENTREPRENEURS OFFER A GLIMMER OF HOPE FOR A SUSTAINABLE SPACE INDUSTRY

The historic flight of SpaceShipOne, like the Wrights' flight at Kitty Hawk, offers a glimmer of hope by removing historical impediments to the industry.[126] The historic flight, inspired by prizes and funded by altruistic billionaires, has led to renewed interest and investment in space enterprises. Moreover, recent events replicate two of the three conditions that were present in fostering the commercial aviation industry: 1) space barnstormers are engaging the public and stimulating innovation in the industry; and 2) guaranteed contracts, prizes, and competitions

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[122] *Just Say Wait to Space Power*, *supra* note 188, at 77.

[123] Logsdon, *supra* note 46, at 10-12.

[124] *Just Say Wait to Space Power*, *supra* note 118, at 73-77.

[125] *See* Logsdon, *supra* note 46; Lewis, *supra* note 47.

[126] Unlike Kitty Hawk, there was not a sustained commercial aviation industry that illustrated what the future may hold. Aviation history illustrates the upcoming benefits of space travel.

are providing financial incentives for technical achievement. However the U.S. government could further support efforts to commercialize. The present conditions will help realize public space travel.

1. *Space Prizes and Awards: Space Altruism and Entrepreneurial Spirit*

The new space age would not be upon us without the efforts of suborbital entrepreneurs, altruistic billionaires and space prize promoters. Like the early days of aviation, these pioneers have raised public awareness, opening a window to the new possibilities and industries that space may provide. Moreover, their efforts have spawned new innovative designs that decreased the price for suborbital space travel.[127] The big dreams of a growing number of competitors in the industry are paving the way for the space barnstorming era.

Prizes spawned suborbital investment, which resulted in the flight of SpaceShipOne. The Ansari X-Prize ("X-Prize"), modeled after the Orteig Prize won by Charles Lindbergh in 1927, was a ten-million dollar purse for the first company to launch a vehicle into space twice within a two-week period carrying the weight of three people.[128] The prize, founded in 1996 by Diamantes, offered an incentive to produce a suborbital craft quicker than would have occurred normally in the highly regulated market.[129] The X-Prize engaged twenty-four teams worldwide and resulted in approximately $400 million worth of investment. The resulting innovations offer launch costs that are .1% of those required to send Alan Shepard on his suborbital flight in 1961.[130] Private investment and competition rapidly decreased launch costs for suborbital spacecraft, making public space travel possible.[131]

Guaranteed contracts, prizes and competitions are also reinvigorating the space industry. While SpaceShipOne already

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[127] *See* Collins, *supra* note 10.

[128] What is the ANSARI X PRIZE?, http://www.xprize.com/about/what_is_the_xprize.php (last visited Jan. 31, 2006).

[129] *Id.*

[130] Collins, *supra* note 10, § 1.

[131] Teams List, http://www.xprize.com/teams/teams.php (last visited Jan. 21, 2006). Burt Rutan, funded by Microsoft Co-Founder Paul Allen, spent $25 million to create SpaceShipOne. Da Vinci Project, a competitor, is expected to complete their craft for a tenth of the cost. Jeff Foust, *Of Rocketships and Paper Clips*, THE SPACE REVIEW, Nov. 22, 2004, http://www.thepacerreview.com/article/274/1.

claimed the X-Prize, many teams are still pursuing suborbital launches in the near future because the X-Prize foundation committed to the X-Prize Cup.[132] The X-Prize Cup will allow paying customers to ride into space and will consist of a series of races, competitions and aerobatic feats.[133] Like the barnstorming era in aviation, the X-Prize Cup is likely to offer many technical innovations promoting the space industry. Shortly after Rutan claimed the X-Prize, Robert Bigelow, founder of Budget Inns, established the fifty-million dollar America's Space Prize.[134] The goal of the new competition is to promote development of an orbital spacecraft that can carry at least five people to dock with Bigelow Aerospace's inflatable space habitats, currently in production.[135] In addition to the prize, a guaranteed minimum number of launch contracts will be awarded to a selected winner.[136] The dreams of space entrepreneurs and altruistic billionaires are opening up commercial space markets, without the governmental help experienced in the aviation industry.

2. *The Commercial Space Launch Amendments Act of 2004: New Law Attempts to Remove Historical Regulatory Impediments to the U.S. Space Travel Industry*

Over the past year, domestic law and policy changed in an attempt to foster the commercial space industry in the U.S. These events convinced the U.S. Government to change its historically restricted view of public space travel. The CSLAA, which was passed on Dec. 23, 2004, eliminates some statutory impediments to the industry and recognizes that "the goal of safely opening space to the American people and their private commercial, scientific, and cultural enterprises should guide Federal space investments, policies, and regulations."[137] Despite

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[132] Leonard David, *New Mexico Chosen for Future Rocket Fest*, MSNBC.com, May 11, 2004, *at* http://www.msnbc.msn.com/id/4952486/print/1/displaymode/1098.

[133] *Id.*

[134] Leonard David, *Rules Listed for $50 Million Orbital Race: Spacecraft Would Have to Fly Twice in Orbit by 2010*, MSNBC.com, Nov. 8, 2004, *at* http://www.msnbc.msn.com/id/6436127/print/1/displaymode/1098/.

[135] *Id.* Other requirements include: no more than twenty percent of the space craft may be reusable; the craft must be able to stay docked for six months; two orbits must be competed at an altitude of 250 miles; and, finally, the feat must be accomplished twice in two months before the Jan. 10, 2010 deadline. *Id.*

[136] *Id.*

[137] CSLAA, 49 U.S.C.S. § 70101(10) (2004).

some potential problems with the new law, recent FAA actions, prior to passage of the CSLAA, suggest that the new legislation will sufficiently facilitate industry growth. In addition to the new legislation, recent changes in NASA directives will likely remove some anti-competitive forces from the market.[138]

The CSLAA is the most significant piece of domestic space law, and its passage shows, for the first time, assertive steps by the government to promote public space travel.[139] The CSLAA sought to achieve four primary goals: 1) to define human space flight as a commercial activity; 2) to streamline the regulatory process by removing unneeded barriers to launch; 3) to balance safety with innovation; and 4) to lessen liability requirements for spaceflight operators.[140] To accomplish these goals, the FAA-AST has been given explicit regulatory authority over the space launch industry.[141]

The CSLAA defines private human space flight. Importantly, the legislation distinguishes between private "space flight participants," "crew" and other space actors.[142] A "space flight participant" is any "individual, who is not crew, carried within a launch vehicle or reentry launch vehicle."[143] Similarly, "crew" has been separated from other actors, being defined as any employee who performs activities directly relating to the licensed launch, reentry or other operation of a launch or reentry vehicle that carries human beings.[144] Also, provisions define launch vehicle types, specifically suborbital vehicles, to eliminate turf disputes within the Department of Transportation ("DOT") over who regulates a part-plane and part-rocket launch.[145] A suborbital rocket is a vehicle, rocket-propelled at least in part, that has a suborbital trajectory and has thrust that exceeds lift *for a majority of the*

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[138] *See* Aldridge Commission, *A Journey to Inspire, Innovate, and Discover: Moon, Mars, and Beyond*, President's Commission on Implementation of United States Space Exploration Policy (June 2004), http://www.nasa.gov/pdf/60736main_M2M_report_small.pdf (last visited Jan. 31, 2006); James Muncy, *A Tale of Two Victories*, THE SPACE REVIEW, Jan. 3, 2005, http://www.thespacereview.com/article/298/1; Robert Zimmerman, *Space Watch: The Outlook For 2005*, SPACEDAILY, Jan. 13, 2005, http://www.spacedaily.com/news/spacetravel-05c.html (discussing NASA's shift away from low-earth orbit to deep-space exploration missions, such as the Moon and Mars).

[139] *See* CSLAA, *supra* note 3.

[140] *Id.*

[141] CSLAA § 70101(13).

[142] CSLAA § 70102.

[143] CSLAA § 70102(17).

[144] CSLAA § 70102(2).

[145] *See supra* notes 81-86 and accompanying text.

rocket-powered portion of the flight.[146] This provision clearly grants authority to the FAA-AST to regulate suborbital launch vehicles. In total, the provisions define individuals and enterprises engaged in human space flight, identify relationships between parties and clear up the ambiguities surrounding different types of launch vehicles.

The CSLAA also removes regulatory barriers for space travel enterprises. The most significant change is the "single license or permit" provision.[147] In the past, multiple licenses have proven prohibitive, both in cost and time, to conducting launch activities.[148] The provision requires that only one permit is needed "to conduct activities involving crew or spaceflight participants, including launch and reentry."[149] Another new regulatory concept is the "experimental permit," based on historical experimental aircraft programs.[150] First, the new provision allows for a streamlined permit process to allow crew training, "research, and development to test new concepts, new equipment, or new operating techniques."[151] Second, one experimental permit will be good for unlimited launches.[152] Other regulatory barriers should be addressed when the Secretary publishes the new proposed regulations over the next year, as required by law.[153] These provisions allow new low-cost suborbital providers to spend their money and time on building spacecraft and not on the regulation and licensing processes.

The CSLAA attempts to balance innovation and safety. Safety requirements dominated the debate preceding passage of the bill.[154] The debate centered on how to prevent avoidable dangerous conduct without inhibiting innovation and growth.[155] The CSLAA attempts to address this by restricting regulation of spacecraft design and operating procedures for eight years after

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146 CSLAA § 70102(19) (emphasis added).

147 CSLAA § 70104(d).

148 *See supra* note 87.

149 CSLAA § 70104(d).

150 CSLAA § 70105a; *see* Dr. James R. Hansen, *Technology and the History of Aeronautics,* http://www.centennialofflight.gov/essay/Evolution_of_Technology/Tech-OV1.htm (last visited Jan. 31, 2006).

151 CSLAA § 70105a(d).

152 CSLAA § 70105a(e).

153 CSLAA § 70120(c).

154 Nathan Horsley, *The Costs and Benefits of Less-Than-Perfect Legislation,* THE SPACE REVIEW, Nov. 29, 2004, *available at* http://www.thespacereview.com/article/275/2.

155 *Id.*; CSLAA § 70101(a)(10)-(15).

enactment, unless the design or procedure "contributed to an unplanned event or series of events . . . that pose a high risk of causing a serious or fatal injury."[156] The compromise in the provision is apparent, but it is unknown how it will be interpreted by the FAA. While some are concerned that this provision would have prevented the second flight of SpaceShipOne,[157] recent actions and notices by the FAA show strong support for a commercial space industry.[158]

Finally, the CSLAA addresses liability for entrepreneurs, employees and spaceflight participants. Most importantly, the CSLAA extends the existing liability indemnification regime for the entire commercial space transportation industry in general and confirms its application to commercial human spaceflight.[159] Also, parties may execute a reciprocal waiver of claims, allowing space enterprises and space flight participants to negotiate their own liability arrangements.[160]

Despite beneficial aspects of the CSLAA, there are some undesirable consequences. First, the CSLAA prevents further launches that carry human beings for three years or until the new regulations are created, whichever occurs first.[161] This provision has the potential to delay some testing necessary for current space enterprises to meet their expected deadlines for passenger space travel.[162] Second, the phrase "poses a high risk of causing serious or fatal injury" may also prove prohibitive, as all launches pose high risk of causing serious or fatal injury.[163] Again, the recent policy actions by FAA do not show a near term threat by the provision, as the FAA has been waiving certain safety regulatory requirements prior to the passage of the CSLAA.[164]

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[156] CSLAA § 70105(c)(2)(C)(ii), (c)(3).

[157] Robert Zimmerman, *Analysis: Congress Restricts Private Space*, UPI, Dec. 9, 2004, http://www.washtimes.com/upi-breaking/20041209-105529-1401r.htm.

[158] *See* Horsley, *supra* note 154.

[159] CSLAA § 70113(f).

[160] CSLAA § 70112(b).

[161] CSLAA § 70120(d)(3).

[162] *See* BBC News, *Virgin Boss in Space Tourism Bid*, Oct. 27, 2004, http://news.bbc.co.uk/1/hi/sci/tech/3693020.stm.

[163] CSLAA § 70105(c)(2)(c)(ii).

[164] Waiver of License Requirement for Scaled Composites' Pre-flight Preparatory Activities Conducted at a U.S. Launch Site, 69 Fed. Reg. 48,549 (Aug. 10, 2004); Waiver of Liquid Propellant Storage and Handling Requirements for Operation of a Launch Site at the Mojave Airport in CA, 69 Fed. Reg. 41,327 (July 8, 2004).

B. THE NEW SPACE RACE: COMPETITORS STRIVE TO LEAD IN THE NEW SPACE AGE

Commercial space travel is a public good that will drive the next era of U.S. technological innovation, fostering economic growth and development. The U.S. must seize the unique opportunities presented in the current economic environment by aggressively promoting the U.S. space industry. For the first time, private industry has demonstrated the ability to meet consumer demand to travel into space. Public space travel, sometimes called space tourism, offers a viable financial incentive for space investment needed to expand the market. This has the potential to create a cycle of innovation, similar to that of the barnstorming era in the aviation industry.[165] The historic flight and the prospect of space tourism changed the current environment in four principle ways: 1) new innovations offer significant increases in safety and performance, decreasing launch costs to levels necessary to meet existing consumer demand and to expand existing markets; 2) new spaceship enterprises, spaceports, and related businesses offer new jobs for highly skilled workers; 3) new technologies offer significant economic benefit; and, 4) new possibilities exist to address national defense issues without militarizing space or reducing reliance on space based assets. However, competition is fierce to acquire dominance in new space markets. U.S. space enterprises, like those in aviation, now need additional changes in law and policy to regain the lead in offering commercial space travel services.

"Public space travel should be viewed as the next large new area of commercial space activity."[166] Current estimates, based on conservative market research, anticipate that suborbital space travel will be a $1.5 billion per year market in fifteen years.[167] Another study showed that twenty percent of all adults would spend four years" salary to spend one week on the

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[165] *See supra* notes 15-21 and accompanying text.

[166] Collins, *supra* note 108, at 98.

[167] Futron Corporation, *Space Tourism Market Study, Orbital Space Travel & Destinations with Sub-Orbital Space Travel,* Oct. 2002, http://www.futron.com/pdf/SpaceTourismMarketStudy.pdf (last visited Jan. 31, 2006) [hereinafter Futron Study]; Alan Breakstone, *Study Confirms Large Space Tourism Market,* SPACE FUTURE JOURNAL, Nov. 17, 2001, http://www.spacefuture.com/journal/journal.cgi?art=2001.11.17.study_confirms (A 2001 study by Space Adventures showed more than 10,000 people per year would pay $100,000).

moon.[168] While the numbers appear small,[169] some estimate space tourism to reach $10 to $20 billion per year within three decades.[170] A Japanese study stated that a $10 billion market for space travel per year can be achieved in only two decades.[171] However, these numbers are conservatively low because space travel is elastic to price.[172] "As the cost of access to space drops to hundreds of dollars per pound from the current $10,000/lb, great growth in the market is projected."[173] For the skeptics, two passengers have already paid $20 million each for an orbital rendezvous with the International Space Station.[174] More than 7,000 people have currently reserved seats on future suborbital flights costing $210,000 each.[175] Moreover, people, companies and industries around the world are preparing to access space.[176] Even Captain Kirk® from the Starship Enterprise®

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[168] Bigelow Aerospace & Patton Boggs LLP, *Beyond Satellites: Stimulating a New Wave of Commercial Space Development*, Bigelow Aerospace, at 9-12 (Dec. 15, 2000), http://www.bigelowaerospace.com/pb_589900_v1.pdf.

[169] In 2001, the FAA estimated America's space-related economic activities, primarily communications satellites, at $61.3 billion annually. Hudgins, *supra* note 28.

[170] Ryabinkin, *supra* note 54, at 108 (citing Leonard David, *Space Tourism in the 21st Century: High Hopes, High Stakes*, Space.com, June 29, 2001, http://www.space.com/missionlaunches/tourism_stakes_010629-3.html)).

[171] R. Stockmans, Patrick Collins & M. Maita, "Demand for Space Tourism in America and Japan, and its Implications for Future Space Activities", AAS paper no AAS 95-605, 91 AAS 601-610 (1995), http://www.spacefuture.com/archive/demand_for_space_tourism_in_america_and_japan.shtml; Dr. Barbara A. Stone, "Space Tourism: Exploring a New Industry", National Aeronautics & Space Administration, Advanced Concepts Office, 96-m-4V, http://www.spacefuture.com/archive/space_tourism_exploring_a_new_industry.shtml (last visited Jan. 31, 2006).

[172] Futron Study, *supra* note 167; Stockmans, *supra* note 171; Stone, *supra* note 171.

[173] Uwe Heuter, *Creating an Airline to the Stars*, AEROSPACE AMERICA, Apr. 1999, at 40.

[174] Dennis Tito and Mark Shuttleworth traveled to the ISS on board a Russian Soyuz. Kevin Bonsor, *How Space Tourism Works*, HowStuffWorks.com, http://www.howstuffworks.com/space-tourism.htm/printable (last visited Jan. 31, 2006).

[175] Associated Press, *'Star Trek' Captain Signs Up For Space: William Shatner is Among 7,000 Seeking Sub-orbital Ride*, MSNBC.com, Oct. 22, 2004, http://www.msnbc.msn.com/id/6309142. Also, Space Adventures has also already booked more than a 100 reservations at $100,000 per seat. X-Marks the Spot—in Space, Oct. 9, 2004, http://www.spaceadventures.com/media/inthenews/2004-10/219.

[176] Oracle Corp. purchased suborbital flights to reward star employees. Press Release, Space Adventures, Ltd., Oracle Gives Developers Opportunity to Reach for Stars with a Trip to Suborbital Space (Dec. 7, 2004), http://www.spaceadventures.com/media/releases/2004-11/22. An 80-year old-woman went on Space Adventures' parabolic flight to simulate zero-g within the earth's atmosphere.

has signed up for suborbital trips.[177] These numbers show that, given the opportunity, people will travel into outer space. Entrepreneurs, in the right regulatory environment would be able to make significant profits.[178] Profits provide the capital needed for investment and investment leads to cycles of innovation. Aviation's history shows that this will lead to safer, more reliable and cheaper launch technologies by providing the means and the incentive to further expand the market. "If we have large enough space markets, especially activities involving large numbers of people in orbit, then the unit costs of serving them could come down, prompting even greater private sector space activity and creating markets for space-related goods and services."[179] Thus, the demand for public space travel will be the catalyst for a sustainable commercial space industry.[180]

In the wake of the X-Prize, new enterprises strive to meet the growing demand for space travel. New services and products are soon expected to hit the market, ranging from training to orbital hotels and manufacturing facilities.[181] The explosion in the aviation industry of new businesses and markets illustrates the potential of a nurtured space industry. In the near term, space travel offers to expand existing suborbital spacecraft, manufacturing and space hospitality industries. First, Virgin Galactic, Space Adventures, Bigelow Aerospace and other companies are creating new high-tech manufacturing and service-oriented jobs.[182] Second, expansion of spaceports and related industries will create new jobs for officials, experts, and other personnel

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Space Adventures, Ltd., *Space Adventures' Client Sets Guinness World Record* (Nov. 29, 2004), http://www.spaceadventures.com/media/releases/2004-11/220. Plans for a reality TV show. Bonsor, *supra* note 174.

177 Associated Press, *supra* note 175.

178 Three thousand flights fully booked on a five passenger RLV would generate $1.5B. The current cost estimates for SpaceShipTwo are $20M. Associated Press, *supra* note 175.

179 Institute of Electrical & Electronics Engineers, *IEEE Say Lowering Unit Cost Should Be Top Space Research Goal*, AEROSPACE DAILY, Dec. 20, 1993, at 451.

180 *See* Collins, *supra* note 108. Commercial aviation grew to 1.5 billion passengers in 2001. *Id.* at 98. The industry is now one of the largest in the world, employing over 100 million people worldwide, either directly or indirectly. *Id.*

181 Alan Boyle, *Spaceports Compete in Race for Business*, MSNBC Interactive, Oct. 7, 2004, *at* http://msnbc.msn.com/id/6191567; Our Future In Space: Opening the Space Frontier, http://www.ourfutureinspace.com/tourism/space_tourism.html.

182 *Id.* Virgin Galactic committed $125.2 million to license and to build five suborbital spacecraft. Associated Press, *supra* note 175. Space Adventures offers Zero-G flights, cosmonaut training, space flight qualification programs, and reservations on future suborbital flights. Space Adventures, Ltd., *Programs, available*

needed to run these new facilities.[183] Third, the high cost currently associated with launches will lead to supportive hospitality industries at spaceports and throughout the country to give the clients their "money's worth."[184] Finally, pursuit of commercial space travel would offer the U.S. a new industry to pursue, relieving the need to hold on to traditional industries that are moving overseas to more economical markets.[185] In the long term, benefits are more profound. Sustainable suborbital travel could create a new wave of high speed transport between countries, faster than the Concorde and without limitations to the markets it can serve.[186] Space-based power stations could beam energy to earth or could provide power to space-based structures.[187]

As the cost to access space decreases, new space technologies will become available that help people, help the environment and help strengthen the U.S. economy. Microgravity research experiments currently being conducted on the ISS illustrate new technologies in industries ranging from energy to medical research. Some of the promising new technologies are improved Zeolites,[188] ZBLAN[189] and synthesized proteins used in medical research.[190] For example, Zeolites produced in space are more efficient at refining oil than their earth-based counterparts. "[A] one percent increase in the amount of gasoline generated from a barrel of oil would result in a $400 million reduction in the balance of payment between America and foreign oil producers."[191] Similarly, space-based power systems offer 300gW of

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at http://www.spaceadventures.com. Bigelow is investing $500 million in new space manufacturing and habitat technologies. *Id.*

183 Derek Webber, *Spaceport Business—Potential Markets Through 2020*, 23rd Annual International Space Development Conference "Settling the Space Frontier" (2004), http://www.spacefuture.com/archive/spaceport_business_potential_markets_thru_2020.shtml.

184 *Id.*; *see* Collins, *supra* note 10.

185 Collins, *supra* note 10, § 6.

186 Bigelow Aerospace, *supra* note 168, at 9-11.

187 *Id.*

188 Zeolites, which have a rigid crystalline structure similar to a honeycomb, are used to refine virtually all of the world's oil. Hydrogen can be stored safely and efficiently in refined space Zeolites. Bigelow Aerospace, *supra* note 168, at 4-6.

189 ZBLAN offers high speed fiber optic cables that can carry 100 times more data than today's silica-based lines. *Id.* at 6-7.

190 Thirty new proteins have been created onboard the ISS, and many have been used to create drugs that are now in various stages of human trials, offering new cures for diseases ranging from cancer to diabetes. *Id.* at 7-11.

191 *Id.* at 4.

clean, sustainable, and safe energy production.[192] A reduction in the use of fossil fuels would benefit the environment and would decrease dependence on foreign energy. These and other technologies will become available when launch costs decrease, making it inexpensive to produce these substances in large quantities and transport them back to earth. While these technologies are promising, the unknown advancements offer the greatest potential. "Capitalism has worked very well on Earth; there is no reason why it will not work in space."[193] The U.S. must take advantage of the near term benefits offered by space travel to lower costs, opening up the long term possibilities of new technologies.

A sustainable space industry will also provide for our national defense. Sustainable space travel will enhance our nation's defense by securing our space assets with a steady, sure, and low-cost way to access space. The debate over whether to militarize space or shift away from space based assets excludes new avenues presented by commercial space travel. Low-cost access to space, made available by sustainable markets, would allow the U.S. to marginalize any asymmetrical advantage by eliminating the time and cost necessary to replace space assets. An attack on space assets would be accompanied by swift and inexpensive launches to replace destroyed assets. Thus, the ability to replace space assets for a low cost and at a moment's notice minimizes any asymmetrical or other advantage gained by destroying U.S. space infrastructure.

The U.S. must regain the lead to maximize the benefit of public space travel. "If space had followed the route that aviation, pioneered by the Wright Brothers, followed so successfully through focusing on commercial passenger services, the U.S. lead in space would surely have been maintained, instead of having been diluted to the extent that both Russia and China now have an order-of-magnitude cost-advantage over the USA in space travel."[194] The Russian space agency is currently the leader in public space travel. No other nation in the world has put private citizens into orbit, much less offered accommodations in orbiting space stations, something the Russians have done for over a decade.[195] Moreover, foreign enterprises have taken the

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[192] *Id.* at 9-11.

[193] *Id.* at 20.

[194] Collins, *supra* note 10, § 6.

[195] Jeffrey M. Lenorovitz, *Privately-backed Manned Flight to Save Mir Space Station Is Set for Historic In-orbit Docking on April 6; Mission Is Funded in Part by MirCorp,*

lead in providing private suborbital flights.[196] The first commercial spaceliner, the VSS Enterprise, was announced by Virgin Galactic founder Richard Branson and expected to be put into service by 2007.[197] Despite initially losing the lead, many American space enterprises are entering the market and, with favorable legislation and policy, can quickly regain the lead. The CSLAA and other policies have laid the groundwork for public space travel, helping to realize these new industries and new technologies. However, much more is needed to assure U.S. dominance in the new "Space Race."

III. THE FUTURE OF SPACE: SOLUTIONS NEEDED FOR A GIANT LEAP FORWARD IN PIONEERING THE FINAL FRONTIER

Further efforts are needed to assure that the U.S. maximizes the benefits of commercial space markets. In June of 2004, the Aldridge Commission addressed several issues needed to expand commercial space markets, recommending that "Congress increase the potential for commercial opportunities related to the national space exploration vision by providing incentives for entrepreneurial investment in space, by creating significant monetary prizes for the accomplishment of space missions and/or technology developments, and by assuring appropriate property rights for those who seek to develop space resources and infrastructure."[198] These and other improvements are necessary for a vibrant U.S. space industry. However, any improvements in space law and policy must recognize that the mere change of law creates unpredictability, which dissuades investors and threatens fragile markets.[199]

There are four principle ways to improve U.S. commercial space markets. First, the CSLAA must be fully implemented and must quickly define any ambiguities that increase risk and deter investment. Second, new prize law and guaranteed contracts must be used to promote technological achievement. Third, tax law must create incentives that stimulate investment and infra-

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Which Has Leased Mir for Commercial Use, PR Newswire Association, Inc., Mar. 28, 2000, at 1. Space Adventures claims to have successfully launched private tourists to the ISS. However, their role was more of a broker for the Russian Space Agency than a provider of space services.

196 BBC News, *supra* note 162.

197 *Id.* The VSS Enterprise will be launched initially from Mojave Airport. *Id.*

198 Aldridge Commission, *supra* note 138, at 33.

199 Hudgins, *supra* note 28.

structure development. Fourth, international law must address property rights in space, orbital debris and high space carrier liability.

Current law and policy must be swiftly implemented in an unrestrictive manner. First, the CSLAA requires that new regulation be promulgated before any further private manned space flights can be conducted.[200] The FAA must promulgate new regulations quickly to prevent any delays in the continued research of private manned space flight. By minimizing the time before flights may resume, the FAA will enable entrepreneurs to build on the recent success of SpaceShipOne. Second, the FAA should be quick to liberally define what constitutes an "unplanned event or series of events . . . that pose a high risk of causing a serious or fatal injury."[201] By liberally defining this provision, the FAA will stimulate innovation and experimentation, eliminating fears that minor technical mishaps will ground future test flights. Third, the FAA should consult with the space industry to give a clear indication as to what regulations will be imposed after the eight year ban, providing industry with the predictability needed to plan future for future investment and growth.[202]

Guaranteed contract, prizes and awards will further promote the industry and expand markets. Throughout history, prizes have promoted technological innovation.[203] The X-Prize was extremely successful in promoting suborbital investment, and America's Space Prize, with the guaranteed contracts, is likely to promote future orbital investment.[204] However, bigger prizes for greater achievement and guaranteed governmental contracts to establish new infrastructure will better expand the industry, garnering competition in the market. Two specific recommendations of the Aldridge Commission are: 1) the expansion of NASA's newly implemented Centennial Challenge program; and 2) new laws that offer more substantial prizes valued between $100 million to $1 billion.[205] The Centennial Challenge program offers up to $50 million in any given year for technical achievements, but no single prize may be in excess of $10 million.[206] Changes to this program should increase program and

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200 CSLAA, 49 U.S.C.S. § 70120(d)(3) (2004).
201 CSLAA § 70105(c)(2)(c)(ii).
202 CSLAA § 70105(c)(3).
203 Aldridge Commission, *supra* note 138, at 32.
204 *Id.* at 32-33.
205 *Id.*
206 *Id.*

prize limits and should focus on achievements that will help grow and sustain the commercial space industry instead of just isolated technical achievements.

The Space and Aeronautics Prize Act ("Prize Act"), currently in the House of Representatives, is suggestive of prize legislation needed to support commercialization of space.[207] The Prize Act establishes a National Endowment for Space and Aeronautics to, among other things, "carry out a program to award cash prizes for outstanding achievements in basic, advanced, and applied research, technology development, and prototype demonstration in conjunction with or independent of NASA"[208] A specific provision of the act establishes a $100 million prize "for the demonstration of a space flight vehicle to carry at least one person to a minimum altitude of 400 kilometers from within the United States or its territories, complete at least three Earth orbits, and return safely."[209] The specifically listed prize may be slightly antiquated after ten years in committee and announcement of America's Space Prize, but the history of aviation and other industries shows that prize legislation fosters innovation and development of markets.[210] New prizes and guaranteed governmental contracts to service and expand infrastructure will offer better return for taxpayer dollars than the $1 trillion already invested in space.[211]

Tax incentives for space investors and enterprises will facilitate needed growth in space markets. "A time honored way for government to encourage desired behavior is through the creation of incentives in the tax laws."[212] First, gains on investments in space related companies should not be taxed. Like tax-free municipal bonds, tax-free space investments will attract investors, drive down the cost of acquiring capital and provide much needed resources for expanding space related enterprises.[213] Second, tax incentives for space enterprises will encourage new competition and investment in the industry.[214] Tax credits can

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[207] H.R. 5336, 108th Cong. (2004).

[208] *Id.* § 2(a),'2(b)(2).

[209] *Id.* § 4.

[210] Douglas O. Jobes, *Will Government-Sponsored Space Prizes Fly?*, THE SPACE REVIEW, Nov. 15, 2004, http://www.thespacereview.com/article/270/1; History of Prizes, http://exploration.nasa.gov/documents/centennialchallenges/History_of_Prizes.pdf (last visited Jan. 31, 2006).

[211] Collins, *supra* note 10, § 6.

[212] Aldridge Commission, *supra* note 138, at 33.

[213] *See* H.R. 914, 108th Cong. (2003).

[214] *Id.*

be offered to enterprises for space infrastructure development spending that promotes a sustainable space market.[215] Moreover, the concept of "Tax-Free Zero-G" can be implemented for a listed number of years to promote research and investment in new potential space industries. "Tax-Free Zero-G" would allow all income generated from outer space or space based assets, excluding satellites, to be exempt from taxation. "A historical precedent to such an effort was the use of federal airmail subsidies to help create a private airline industry before World War II."[216] By implementing these pro-growth tax policies for outer space the U.S. can best maximize investment in and expansion of national space industries.

International law needs to be changed to allow further expansion of space markets. First, international law must protect property rights in outer space. The Outer Space Treaty needs to be replaced with a system that allows for a nation to have rights in outer space and on celestial bodies.[217] Also, the unsigned and unratified Moon Agreement needs to be specifically denounced by the U.S.[218] The uncertainty created by disallowing property rights in space "could strangle a nascent space-based industry in its cradle; no company will invest millions of dollars in developing a product to which their legal claim is uncertain."[219] Modernizing restrictive space property rights will allow clear legal claim to facilities or products produced in outer space. Second, known issues that can prevent expansion of markets should be addressed quickly to remove impediments to the market. For example, removal and mitigation of orbital debris will be necessary for successful commercialization of space. Third, and most importantly, the existing liability regime established in the Outer Space Treaty and Liability Convention must be renegotiated.[220] While potentially unlimited strict liability threatens the commercial space industry, many nations, including those with a space industry, will unlikely waive damage caused by a foreign nation or entity; however, attempts must be made to reach a compromise to limit liability. If an international consensus cannot be reached, domestic law must expand to further indemnify

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[215] *Id.*

[216] Aldridge Commission, *supra* note 138, at 33.

[217] Outer Space Treaty, *supra* note 88, art. II.

[218] Moon Agreement, *supra* note 98.

[219] Aldridge Commission, *supra* note 138, at 34.

[220] *See* Outer Space Treaty, *supra* note 88, art. VII; Liability Convention, *supra* note 95.

U.S. space entities pioneering the new frontier.[221] The suggested changes in international law will promote growth and eliminate uncertainty in space markets by solidifying world support addressing known issues that limit expansion into space, and providing a risk sharing mechanism that limits liability for pioneering enterprises.

With all of these proposals, the government pays nothing for failure. The suggested solutions "create large amounts of investment and hence, technical progress, all at very little expense or risk to the government."[222] Properly implemented, each of the changes will fix the cost of innovation and will make sums payable only after successful completion. Moreover, the changes will send a clear signal to the space industry, illustrating a predictable future that encourages market participation.

The suborbital flight of SpaceShipOne brought about recent changes in perception, policy and law, removing historical impediments that prevented formation of commercial markets and denied the U.S. the economic benefit predicted by other historic industries. Recent changes are a small first step that, when combined with the proposed changes, will help the U.S. realize the future scientific, economic and strategic benefits of space. "The 20th Century has been the American Century in large part because of great inventors like the Wright brothers. May we follow their flight paths and blaze our own."[223]

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[221] *See generally* Ryabinkin, *supra* note 54, at 119.

[222] Aldridge Commission, *supra* note 138, at 33.

[223] Bill Gates, 75th Anniversary TIME Salute in Washington, D.C. (Mar. 3, 1998), http://www.microsoft.com/billgates/speeches/gatessalute.asp.


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